



Badger Meter Europa GmbH

MN 80 series

Oval gear flow meter



INSTRUCTION AND OPERATION MANUAL

November 2006

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1. Basic safety recommendations

The manufacturer is not liable for damages that result from improper or not in accordance with the requirements use.

The meters are constructed according to state-of-the-art technology and tested operationally reliable. They have left the factory in a faultless condition concerning safety regulations.

The mounting, electric installation, taking into operation and maintenance of the meter may only be carried out by suitable technicians. Furthermore the operating personnel has to be trained by the operating authority and the instructions of this manual have to be followed.

Basically, you have to respect the regulations for the opening and repairing of electrical equipment valid in your country.

2. Repairs

If you should send back a flow meter in operation, please take notice of the following points:

- Please enclose a description of the error as well as a precise statement of the measured medium (if necessary a safety specification sheet).
- The meter has to be in a cleaned condition (outside and inside). Especially with harmful measuring mediums you have to pay attention that there are no impurities nor residues in the pipe or at the connections.
- If it is not possible to clean the meter completely, particularly with harmful materials, do not send back the meter.
- Please copy and fill in the harmless declaration at the end of this manual and send it back together with the meter to be repaired.

We reserve the right to repair only cleaned meters. Costs, which result from insufficient cleaning, will be charged to you.



3. To the owner

Thank you for purchasing a MN series flow meter. Please take a few minutes to read through this manual before installing and operating your meter. If you have any problems with the meter, refer to the maintenance and trouble shooting sections of this manual.

This manual contains connection and operating instructions for the MN4 series meters. If you need further assistance, contact us or your local representative for advice. The MN series flow meter has incorporated the oval rotor principle into its design. This has proven to be a reliable and highly accurate method of measuring flow. Exceptional repeatability and high accuracy over a wide range of fluid viscosities and flow rates are features of the MN series flow meter design. The low pressure drop and high pressure rating means the MN series flow meter is suitable for both gravity and pump (in-line) applications.

4. Operation

Please read this information carefully before use!

Before use, confirm the fluid to be used is compatible with the meter, or consult your local representative for advice. This meter will handle particle sizes up to 0.075 mm/0.0003". To prevent damage from dirt or foreign matter, we recommend a Y or basket type 200 mesh strainer be installed as close as possible to the inlet side of the meter. To prevent damage to the meter slowly fill the system with fluid (this will prevent damage caused by air purge). Note: Failure to do this could damage the meter. For pump applications, turn off the pump at the end of each day.

5. For the use in ex-zones

- Reed switch: Connection to intrinsically safe electric circuit (simple electrical equipments must be operated intrinsically safe with a suitable barrier according to EN 50020).
- Equipotential bonding has to be ensured upon the pipe system.
- Meters with plastic housing (PPS): Please do not clean the meters with a dry cloth as this would cause electrostatic charge.
- The fluid conductivity must be better than 1000 pico/ Siemens/meter to avoid electrostatic charges.
- Ambient temperature must be between - 20°C and + 40°C (T4).
- PTB - Deluxe LCD
EEX ia IIC T6 (PTBnr EX-93.C4033X)



6. Model MN80

6.1 General information

The MN80 series flow meters are only available in aluminium. Rotors are made from aluminium.

The MN80 series mechanical displays have a resettable batch totaliser and non-resettable accumulative totaliser.

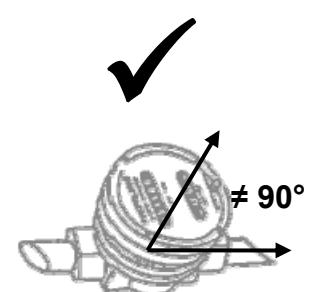
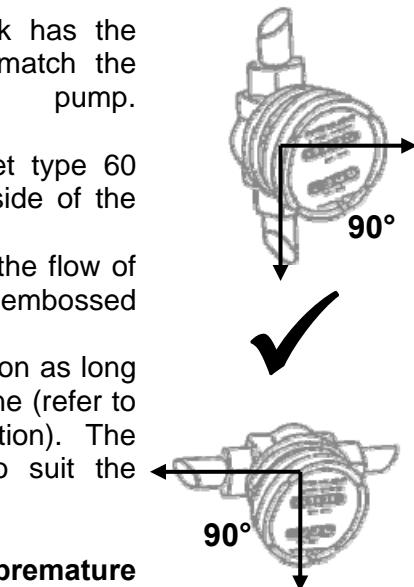
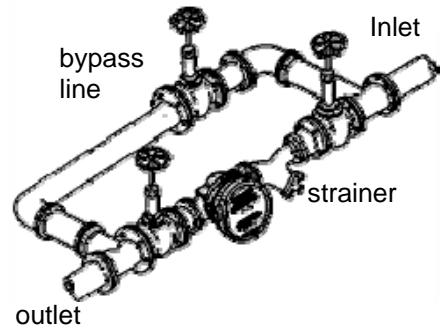
The MN80 series is also available with either; standard pulse, standard LC display and pulse, Deluxe LC display and pulse (see separate manuals)

6.2 Installation

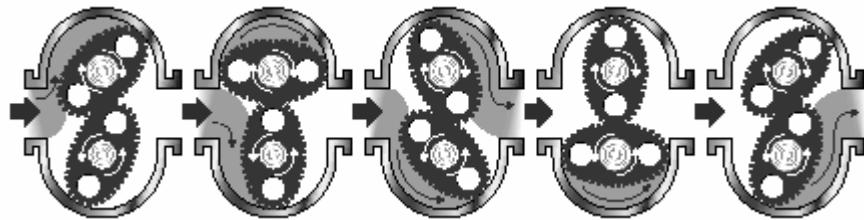
1. We recommend that when setting up pipework for meter installations a bypass line be included in the design. This provides the facility for a meter to be removed for maintenance without interrupting production (see right fig.).
2. Use thread sealant on all pipe threads.
3. For pump applications ensure pipe work has the appropriate working pressure rating to match the pressure output of the pump.
4. Install a wire mesh strainer (Y or basket type 60 mesh) as close as possible to the inlet side of the meter.
5. Ensure that the meter is installed so that the flow of the liquid is in the direction of the arrows embossed on the meter body.
6. The meter can be installed in any orientation as long as the meter shafts are in a horizontal plane (refer to figure on the right for correct installation). The register assembly may be orientated to suit the individual installation.

Note: Incorrect installation can cause premature wear of meter components.

7. Do not overtighten meter connections.
8. It is important that after initial installation you **fill the line slowly, high speed air purge** could **cause damage** to the rotors.
9. Test the system for leaks.
10. Check the strainer for swarf or foreign material, after the first 200 litres check periodically, particularly if the flow rate decreases.



6.3 Operation



When fluid passes through the meter, rotors turn. The gear located on top of one of the rotors drives the mechanical registers gear train which provides an accurate readout.

6.4 Service instructions

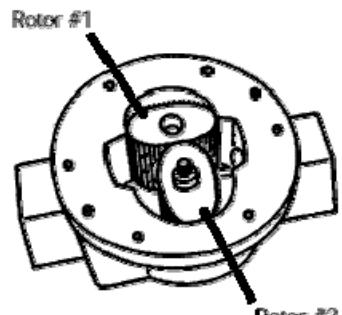
Disassembly:

Ensure that the fluid supply to the meter is disconnected and the line pressure is released before disassembly. Refer to the exploded parts diagram for item numbers.

- 1) To remove the analog display refer to "analog register supplement" MS548.
- 2) Remove the six cover plate screws (item 12) and remove the cover plate (item 11).
- 3) Remove the eight meter cap screws (item 5) and remove the meter cap (item 4).
- 4) Remove rotors (item 3).

Reassembly:

- 1) Clean all components before reassembly.
- 2) Before reassembly check the condition of the rotors (item 3). Replace if necessary.
- 3) Replace the rotor (with the gear) on the short shaft in the housing then place the 2nd rotor onto the shaft so as the rotors are at 90° to each other (refer to fig 3). Check rotor operation by turning either of the rotors. If the rotors are not in mesh correctly or do not move freely remove one of the rotors and replace it correctly at 90° to the other rotor. Recheck the operation of the rotors.
- 4) Inspect the gears (item 6) in the meter cap (item 4) for wear. Replace if required, refer to spare parts listing.
- 5) Replace the o-ring (item 2) into the groove in the meter cap, if the O-ring has been distorted or is damaged in any way replace it with a new part.
- 6) Replace the meter cap, making sure the locating pins line up with the holes in the meter cap and the gear on the rotor meshes correctly with the gear in the meter cap (item 4). Insert the allen screws (item 5) and tighten in the sequence 1, 6, 2, 5, 3, 7, 4, 8.
- 7) Inspect the drive dog, O-ring (item 10), and output gear (item 7) for wear or damage (replace faulty components if necessary).



Rotors must be at 90° to each other.



8. Replacement of output shaft, bush and seal.

Disassembly of output shaft:

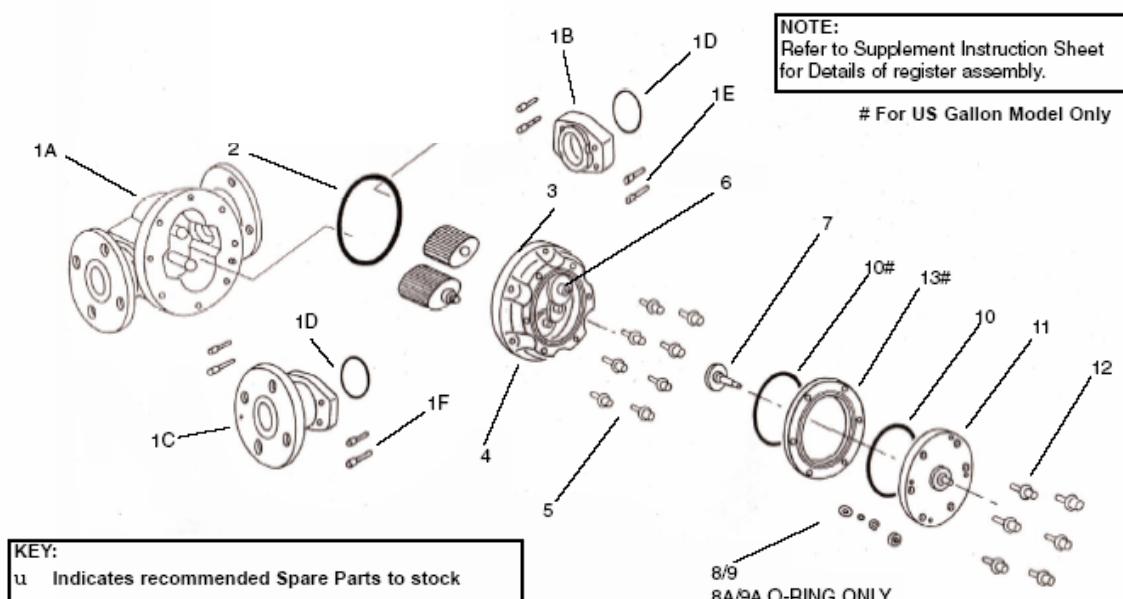
- Remove the drive dog.
- Remove the circlip and push out the output shaft assembly, including washer (items 7, 8, 9).
- Remove the seal.
- Carefully press out the output shaft bush (if required).

Assembly

- Carefully press the new output shaft bush into place (use Loctite Primer 747, as per instructions, followed by sealant Loctite 680).
- Insert a new seal into the groove of the output shaft bush.
- Replace the output gear and washer and replace the circlip to lock the output gear shaft into place.
- Replace the drive dog (item 13) and tighten the grub screw onto flat face of shaft.

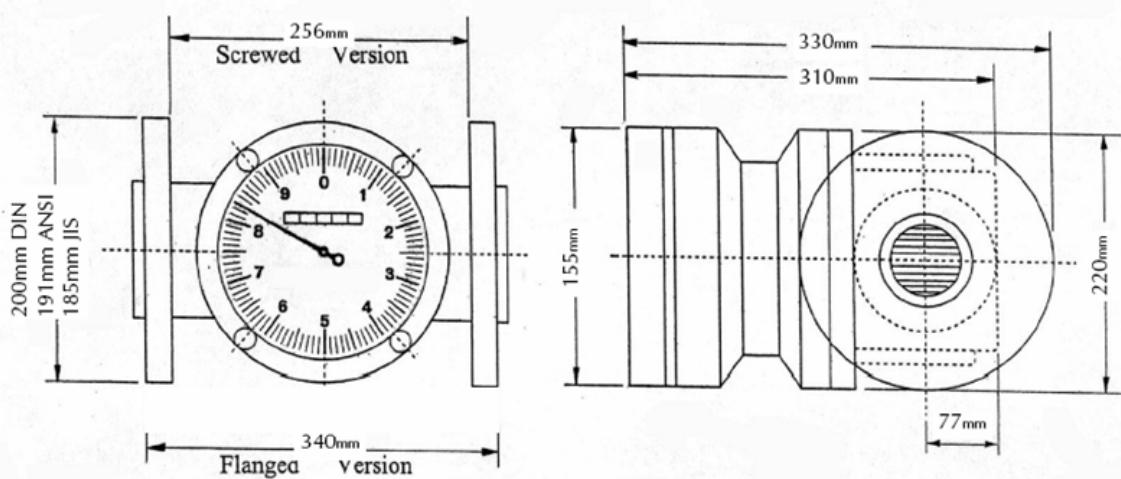
- Place the O-ring (item 10) into the groove in the cover plate (replace the O-ring seal if required).
- Place the cover plate onto the meter. Replace the cover plate screws and tighten the six cap head screws (item 12) firmly.
- To install the analog register refer to "analog register supplement" MS548.**
- Test the meter by turning the rotors with a finger or by applying low air pressure to one end of the meter, before returning meter to the line.

6.5 Meter parts listing



Item No.	No. Off.	Rec. Parts	Part or set (order from this column only)	Part description
1A	1		MS597S	Meter body module (Aluminium)
1B	2		MS578S	3" BSP flange (Aluminium)
1B	2		MS578NS	3" NTP flange (Aluminium)
1C	2		MS579S	3" ANSI-150lb flange (Aluminium)
1C	2		MS579DS	3" DIN16 flange (Aluminium)
1C	2		MS579JS	3" JIS-10K flange (Aluminium)
1D	2	u	BS273S	O-ring (NBR)
1D	2	u	BS273ES	O-ring (EPDM)
1D	2	u	BS273TES	O-ring (Teflon)
1D	2	u	BS273VS	O-ring (Viton)
1E	4	u	MS585S	Bolt set (to suit 1B only)
1F	4	u	MS528S	Bolt set (to suit 1C only)
2	1	u	BS262S	O-ring (NBR)
2	1	u	BS262ES	O-ring (EPDM)
2	1	u	BS262TES	O-ring (Teflon)
2	1	u	BS262VS	O-ring (Viton)
3	1	u	MS582MS	Rotors (Aluminium)
4	1		MS599S	Meter cap liters (Aluminium) incl. gear set
4	1		MS598S	Meter cap US gallon (Alu) incl. gear set
5	8		MS243S	Meter cap screws (standard)
6	1	u	MS616S	Complete gear set – Liters
6	1	u	MS625S	Complete gear set – US Gallons
7	1	u	MS97S	Output gear and shaft assembly
8	1	u	MS78S	Cover plate seal/bush set standard
9A	1		N7-007S	Standard O-ring (NBR)
10	2		BS145S	O-ring (NBR)
10	2		BS145ES	O-ring (EPDM)
10	2		BS145TES	O-ring (Teflon)
10	2		BS145VS	O-ring (Viton)
11	1		MS327S	Cover plate (Aluminium) includes bush
12	1		MS312S	Cover plate screws
13	1		MS423	Spacer ring (US gallon models only)

6.6 Dimensions



6.7 Specifications

Flow ranges (liter per minute/US gallons per minute)	
Above 5 centipoise	100 to 700/ 26.4 to 185
Accuracy of reading	+/- 1%
Maximum viscosity	1000 centipoise
Maximum operating pressure	1200 kPa / 175 PSI / 12 BAR
Maximum operating temperature	80°C / 176°F

6.8 Troubleshooting

Trouble shooting guide		
Trouble	Cause	Remedy
Fluid will not flow through the meter	A) Foreign matter blocking rotors B) Line strainer blocked C) Damaged rotors D) Meter connections overtightened E) Fluid is too viscous	A) Dismantle meter, clean rotors (strainer must be fitted in line). B) Clean strainer C) Replace rotors (strainer must be fitted in line) D) Re-adjust connections E) See specifications for maximum viscosity
Reduced flow through the meter	A) Line strainer partially blocked B) Fluid is too viscous	A) Clean strainer B) See specifications for maximum viscosity
Meter reading inaccurate	A) Fluid flow rate is too high or too low B) Fluid is too viscous C) Excess wear caused by incorrect installation	A) See "specifications" for minimum and maximum flow rates B) Bleed air from system C) Check meter body and rotors. Replace as required. Refer to installation instructions.
Fluid flows but no reading on meter	A) Bevel gear is loose on shaft B) Rotor drive gear is damaged C) Transmission gear is damaged D) Register gear is damaged	A) Tighten grub screws B) Replace rotor C) Replace gears D) Replace register assembly
Fluid leaks into register	A) Seal worn or damaged on the cover plate	A) Replace seal (check seal compatibility with fluid)



7. Analog register for models with and without encoder

7.1 Service instructions

Removal of register assembly:

Ensure that the fluid supply to the meter is disconnected and the line pressure is released before disassembly. Refer to the exploded parts diagram figure 1 and 2, respectively for item numbers.

1. Remove the four screws (item 27) located under the register housing.
2. Remove the register assembly from the meter.
3. Check the gasket (item 24) for damage, replace if necessary.

Reassembly

1. Clean all components before reassembly.
2. Install the gasket (item 24)
3. Align the drive dog on the register assembly with the mating dog on the meter body/cap assembly.
4. Position the register assembly, in the preferred orientation, then fit and tighten the 4 screws (item 27).
5. Test the register by turning the rotors with a finger or by applying low air pressure (no more than a good breath) to one end of the meter, before re-installing meter to the line.

Dismantling register assembly WITHOUT rotary encoder:

Refer to figure 1 unless otherwise stated

1. Undo the four screws (item 1) and remove the clamp ring (item 2)
2. Remove the glass cover (item 4) and inspect the seal (item 3) for damage, replace if necessary.
3. Carefully remove the plastic pointer (item 5) so as not to damage the stem which is a push fit onto the needle shaft (item 11, refer figure 2).
4. Undo the register face screws (item 6) and remove the register face.
5. Undo the screws (item 8) and remove register mechanism tilting slightly so as to clear the reset arm (item 18) and shaft collar (item 20).
6. To remove the reset arm, undo grub screw (item 23) and remove the reset knob (item 21). Slide the reset arm from the housing being careful not to loose or damage the o-ring (item 22). Inspect o-ring for damage, replace o-ring if necessary.
7. Assembly is the reverse of the above procedure.

Dismantling register assembly WITH rotary encoder:

Refer to figure 1 unless otherwise stated.

1. Follow steps 1, 2 ,3 and 4 as above.
2. Undo grub screw (item 14) to enable the shaft coupling (item 12) to be withdrawn from encoder shaft (refer item 16, figure 2).
3. Undo two socket head cap screws (item 9) and slide encoder housing away from register housing. If it is necessary to remove the encoder coupling (item 12) from the encoder, record the distance the coupling is from the face of the encoder so it can be replaced in the same position. This is important to prevent overloading of the encoder bevel drive gears.
4. Follow steps 5 and 6 above to complete disassembly.
5. Assembly is the reverse of the above procedure.



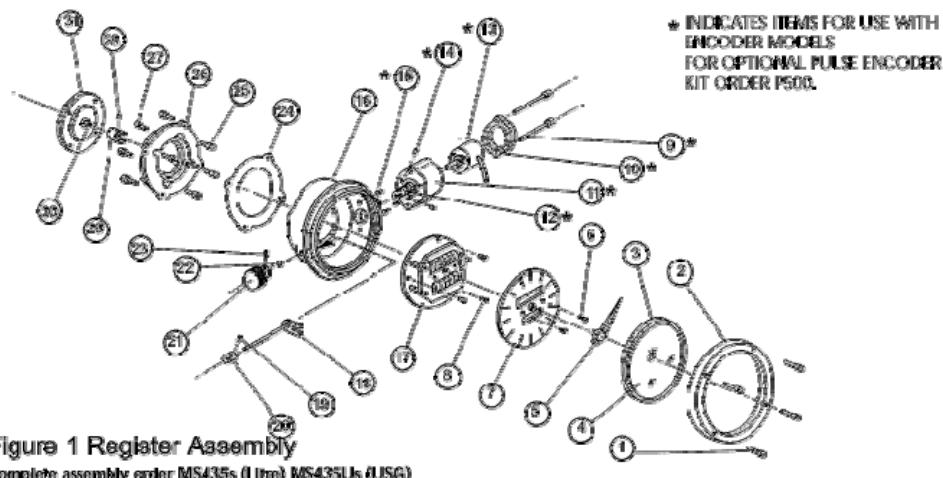
Dismantle counter wheel assembly:

Refer to figure 2 unless otherwise stated

1. Dismantle the register assembly as previously detailed.
2. Undo the 4 screws (item 1) and remove the counter wheel assembly (item 3).
3. Undo the two countersunk screws (item 17) and remove the encoder shaft (item 16) complete with bearing block (Item 15), bevel gear (item 18) and spur gear (item 13). Do not attempt to remove this gear from the shaft.
4. Further disassembly is done by removing the remaining grub screws (item 19 and 21), and withdrawing the shafts (items 6 & 11).
5. Assembly is the reverse of the above procedure.

Refer to the standard mechanical register instruction sheet for further advise on gearbox, output shaft and seal related maintenance issues.

7.2 Register parts listing



Item No.	No. Off.	Rec. Parts	Part or set (order from this column only)	Part description
1	4	MS444		Clamp ring screws
2	1	MS443	MS443s	Clamp ring
3	1	MS446		Seal
4	1	MS445	MS445s	Glass face
5	1	MS448	MS448s	Pointer
6	2	MS439		Screw
7	1	MS447	MS447s	Fascia litres
7	1	MS447U	MS447Us includes item 6	Fascia US gallons
8	3	MS464	MS464s	Screw
9*	2	MS442	MS442s	Cap screw (encoder model only)
9	2	MS115	MS492s	Cap screw (without encoder)
10*	1	MS441	MS441s includes 2 x item 9*	Cover (encoder model only)
10	1	MS441-B	MS441-Bs incl 2 x item 9 + BS120	Cover (without encoder, also requires 1 x BS120 o-ring)
11*	1	MS440	MS440s includes item 9* + 10*	Encoder housing (encoder model only)
12*	1	MS494		Encoder coupling (encoder model only)
13*	1	MS407		Encoder (100 pulse per rev) (encoder model only)
14*	4	MS151		Grub screw (encoder model only)
15*	3	MS437	MS407s	Screw (encoder model only)
16	1	MS435	MS435Hs	Register housing
17	1	MS143	MS143s includes item 8	Reset mechanism assembly (refer figure 2)
18	1	MS463L		Reset arm
19	1	MS146		Grub screw
20	1	MS450	MS463Ls	Shaft collar
21	1	MS451		Reset knob
22	1	BS008		O-ring (Nitrile)
23	1	MS146	MS451s	Grub screw
24	1	MS107	MS107s	Gasket
25	4	MS514		Bolt
26	1	MS326		Register adapter
27	4	MS465	MS326s	Bolt
28	1	MS146		Grub screw
29	1	MS246		Drive dog
30	1	MS309	MS246s	Output shaft (long)
31	1	MS327	MS327s	Refer to mech. meter instruction sheet Cover plate (aluminium)
31	1	MS327-1	MS327-1s	Cover plate (stainless steel)



7.3 Counter parts listing

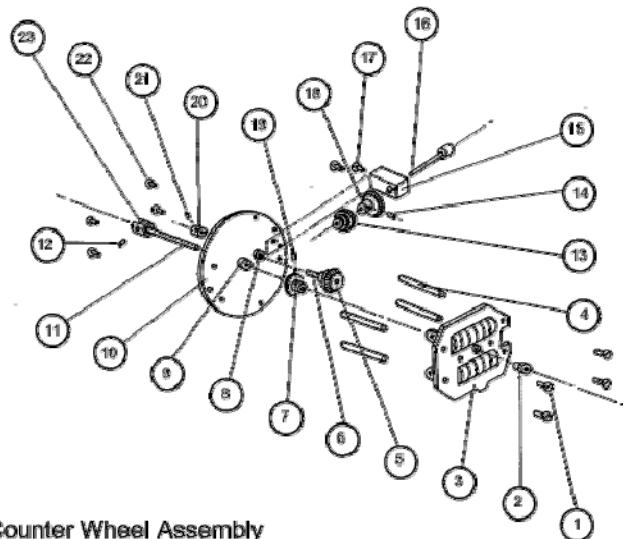


Figure 2 - Counter Wheel Assembly

Complete assembly order MS143s

Item No.	No. Off.	Rec. Parts	Part or set (order from this column only)	Part description
1	4	MS438		Screw
2	1	MS454		Bush – needle shaft (top)
3	1	MS142		Register display mechanism
4	4	MS453		Spacer
5	1	MS462		Bevel compound gear
6	1	MS308		Output shaft (short)
7	1	Ms460		Gear
8	1	MS458		Bush – idler shaft
9	1	MS457		Bush – needle shaft (bottom)
10	1	MS436		Register chassis
11	1	MS452	MS143s	Needle shaft
12	1	MS146		Grub screw
13	1	MS240		Spur gear
14	1	MS146		Grub screw
15	1	MS455		Encoder shaft housing
16	1	MS456		Encoder shaft
17	2	MS437		Cap screw
18	1	MS461		Bevel gear
19	1	MS146		Grub screw
20	1	MS459		Idler shaft gear
21	1	MS146		Grub screw
22	4	MS437		Cap screw
23	1	MS409		Drive dog



7.4 Encoder wiring

The encoder (item 13, refer figure 1) is an optical incremental shaft encoder. It has a 1000 pulses per revolution resolution output. The output is an open collector with 3 phases (A, B and Z) that can function on a 5 to 12 Volts DC power supply.

Please read this information carefully before use!

Optical encoders are delicate instruments and should be treated with care. Shock loads and incorrect electrical connection will lead to encoder damage.

To avoid electrical interference, use quality shielded cable to connect the encoder to the recording instrument, ensure the cable shield is grounded, as shown in wiring diagram below. The maximum allowable transfer distance for open collector encoders is 50 metres.

To avoid damage to the encoder, please observe the manufacturer's electrical specifications, wiring table & wiring diagram shown in below.

Electrical Specifications:

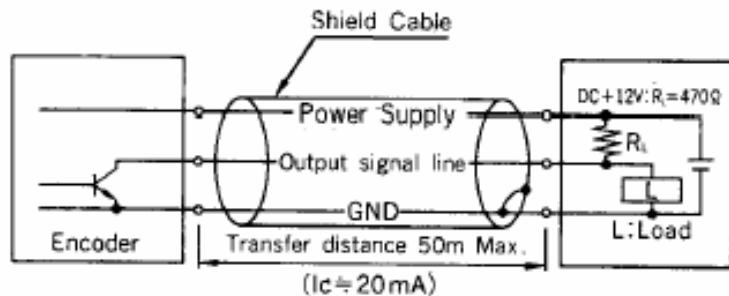
Resolution	1000 pulse per rev.
Power supply	DC5V -5% ~DC12V +5%
Current consumption	50mA maximum
Output from (open collector)	
Maximum allowable output voltage	40V
Maximum sink current	30 mA
Maximum response frequency	200 kHz
Operating temperature range	-10°C - +70°C
Encoder protection	IP 50
Maximum signal transfer distance	50 metres

Wiring colours table:

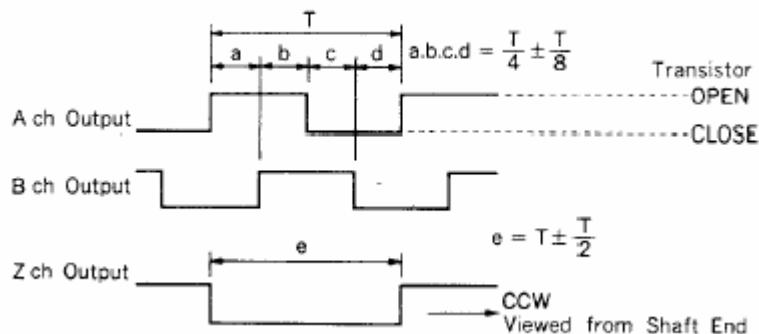
Lead colour	Function
Red	DC + 5 ~ 12V
Black	GND
Yellow	Z channel output
White	GND
Blue	A channel output
Green	B channel output
Brown	--
Orange	--



Wiring diagram :



Phase correction output:



Note: The above voltage waveform can be obtained by loading the output with a resistor (R_L) as shown in the figure above.



8. Warranty

Badger Meter warrants meters and parts manufactured and supplied by it hereunder to be free from defects in materials and workmanship for a period of 18 months from date of shipment or 12 months from date of installation, whichever period shall be shorter. If within such period any meters or parts shall be proved to seller's satisfaction to be defective, such meters or parts shall be repaired or replaced at seller's option. seller's obligation hereunder shall be limited to such repair and replacement and shall be conditioned upon seller's receiving written notice of any alleged defect within 10 days after its discovery and, at seller's option, return of such meters or parts to seller, f.o.b. its factory. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES WHATSOEVER INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES (EXCEPT OF TITLE) OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Badger Meter shall not be liable for any defects attributable to acts or omissions of others after shipment, nor any consequential, incidental or contingent damage whatsoever.

Note:

This warranty does not form part of, nor does it constitute, a contract between Badger Meter and the end user. It is additional to any warranty given by the seller of the products and does not exclude, limit, restrict or modify the rights and remedies conferred upon the end user, or the liabilities imposed on the seller, by any statute or other laws in respect of the sale of the product.



9. Return of goods for repair / harmlessness declaration

Please copy, fill in and sign hereafter harmlessness declaration and enclose it for any return of goods you may send back for repair.

No repair will be performed prior to receiving the harmlessness declaration duly filled and signed.

Harmlessness declaration

To : _____

Attn. : _____

From : _____

Dept. : _____

Please note that no repair will be performed prior to receiving of this declaration duly signed by you!

Please send all parts clean from medium and inform us about possible medium wastes remaining in the part. For this purpose, please use this form. A security specification sheet of the medium must accompany this declaration in the following cases: Toxical, dangerous or objectionable media, or media belonging to any dangerous materials class. We inform you that uncleaned parts lead to additional costs. Extra clean costs will be charged to you. Furthermore, we reserve us the right to send the parts back to you for cleaning!

Declaration

We herewith confirm that the part(s) sent for repair has/have been cleaned and is/are free of any liquid and/or solid wastes of the medium and/or cleaning medium: Any eventually remaining wastes are:

- harmless
- dangerous, toxic, etc. – Security specifications are attached

Signature of person in charge: _____

Name of the person in charge in capital letters: _____

Date: _____

Company stamp: _____



Hotline

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